Still unaddressed: a submerged rock approximately 6 miles SW of the site would narrow the range of safe approaches for tankers – particularly if they weren't permitted to use the lanes coming from the NW and SE. The mean depth of the rock is 42 ft (7 fathoms); the FSRU draft-loaded is 43.3 ft. The range of tides in the area is ~4.5 feet.[117] (Anecdotally, the risk of a tanker grounding on that rock might be on the same order of magnitude as that of an automobile on Pacific Coast Highway in Malibu striking a pedestrian standing in the median divider lane – an event which occurs several times per year.)

G434-76

Exclusion Zone and Precautionary Zone

The analysis of these zones and their potential impacts is incomplete.

Centering the 500 m (1,640 ft.) Exclusion Zone on the FSRU mooring point means that one end of the FSRU (approx. 1,000 ft. long) would always be within ~640 ft. of the edge of the zone. This means that either the effective exclusion would be only a third of the nominal distance (roughly), or that the zone would have to be modified to migrate along with the FSRU's movements. In the latter case, its radius would be measured from the center of the FSRU itself, in whatever orientation it happened to be; and the effective zone would have a radius of ~1,000 ft (FSRU length) *plus* an additional 500 meters, or 2,640 ft. total. This would mean that the total area of the effective zone would be .78 sq. miles (statute).[118] By either solution (widening the zone or allowing it to migrate with the FSRU) the DEIS/R has not adequately analyzed the true scope and impacts of the zone.

In any case, the Exclusion Zone would not adequately encompass the actual significant vessel activity of the Applicant. Tankers would be coming and going at the rate of 2-8 per week (recall the discussion of number of tankers necessary at peak capacity), so one or several would almost always be in the immediate vicinity; and tugs would be coming and going at a rate of 4 transits per tanker, further widening the area of traffic complications.

G434-77

Needless to say, the impacts on other commercial and recreational vessels are not completely addressed; significantly more vessels would be "disrupted" than the DEIS/R acknowledges. The Applicant states, "The location of the FSRU has been sited away from popular recreation areas and active OCS platforms, which minimizes the effect of increased marine traffic trips."[119] However, as pointed out elsewhere, a significant number of recreational craft transit the zone on their way from L.A.-area marinas to the Channel Islands.

The location and radius of the Precautionary Zone means that such westbound vessels would necessarily experience "serious disruption," notwithstanding BHPB's definition of it ("when a vessel cannot proceed to its intended destination due to exclusion from an area…the need to use alternate routes during exclusion does not constitute a serious disruption").[120] But a vessel that "cannot proceed to it's intended destination" is *ipso facto* disrupted. Here, westbound vessels

G434-78

117 Scoping draft EIS/EIR, 2.5.2.
118 21,895,695 sq.ft.
119 Matrix, at 16.
120 Matrix, at 9.

G434-76
The FSRU would travel to and from the proposed port location at commissioning and decommissioning, taking a transpacific route; neither the FSRU nor LNG carriers would approach the location cited in the comment.

No LNG carrier would approach closer to the shore than the location of the FSRU; therefore, they would avoid the submerged rock.

G434-77
Sections 2.2.4, 4.3.1.4, and 4.3.4 address the size of the safety zone, how it would be established, and the potential impacts on marine traffic. The FSRU would be able to rotate 360° around the mooring turret. The safety zone would extend 500 m from the circle formed by the FSRU's stern, the outer edge of the facility, rotating around the mooring turret. See Figure 4.3-4 for an illustration of the potential safety zone and area to be avoided. The safety zone could not be made any larger because its size is governed by international law.

G434-78
Sections 2.2.4 and 4.3.1.4 discuss the stipulations for safety zone and areas to be avoided. Safety zones and areas to be avoided would be marked on nautical charters so mariners could plan accordingly.

would have little choice but to steer directly into the oncoming traffic of the SE-bound shipping lane because *the 2.0 NM radius of the Zone directly abuts the shipping lane*. (See FIGURE 2, above).

G434-78 cont'd

At the same time, the Precautionary Zone also immediately abuts the eastern boundary of the Pt. Mugu Sea Range (missile range). (This proximity has been "fudged" in the DEIS/R, which states that the distance from FSRU to the Sea Range is 2.4 NM;[121] whereas precise map measurement shows the FSRU to be 2.0 NM from the range boundary. See FIGURE 2.) As in the case of the Shipping Lane, commercial and recreational vessels approaching the FSRU from the south or east would be detoured directly into the missile range.

G434-79

Even more significant than the fact that vessels would be disrupted is that they would encounter a complex area of limited access zones (FSRU, shipping lane, missile range). Any navigator "half asleep at the wheel" might become confused about which zones are off-limits and which are not, so might react in a less than rational manner. Add another LNG tanker (or two) and a few tugs into the mix, and the result could be chaos – the navigational equivalent of an Italian traffic roundabout. For instance, how would the captain of a recreational motorboat respond if he could clearly see that he should pass a tanker to port, but was getting radio advice that he should pass to starboard to avoid one of the limited access areas?

G434-80

Apropos, the area sees a number of high-speed "cigarette boats," particularly in the Summer months. Based on my own frequent observance of such boats in waters closer to shore, their operators typically display a reckless sort of "cowboy" behavior. They can be reasonably expected to either not have adequate GPS or radio gear, or to not closely monitor such devices. We can only wonder how they would react to simultaneous conflicting course recommendations.

Perhaps not coincidentally, whereas the Applicant previously proposed a Precautionary Zone of 2.5 NM, it appears to have been reduced to 2.0 NM arbitrarily, when it was realized that the greater radius would overlap the shipping lane. If BHPB were to use any of the more reliable models of blast radius[122] – or to hold to its own prior statement that the blast radius could be five miles[123] – this means that the potential blast radius of an explosion radically overlaps the shipping lane.

In short, the exclusion zone is both too small for safety, and too large (and complex) in terms of impacts on other boat traffic. Either way, it problematic; the proposed project location has unmitigable impacts no matter what the size of the exclusion zone.

G434-81

121 2-2.

122 From e.g., Jerry Havens, James Fay, or even FERC.

123 Commentary in Ventura Star, March 28, 2004.

G434-79

Table 2.1-2 lists distances to points of interest from the FSRU, including the Point Mugu Sea Range.

Figure 2.1-2 depicts the boundaries of the Area to be Avoided (ATBA) and the Point Mugu Sea Range. The ATBA is outside of the boundaries of the Point Mugu Sea Range.

Vessels in the Santa Barbara Channel TSS would not have to change course as they pass the ATBA. Sections 2.2.4 and 4.3.1.4 describe the stipulations of the ATBA.

G434-80

Section 4.3.1 discusses existing maritime conditions, and Section 4.3.4 discusses impacts and measures to mitigate impacts on mariners, including safety measures that would be used. Standard nautical "rules of the road" would apply at all times. Safety zones and the Area to be Avoided would be marked on nautical maps so that mariners could plan accordingly.

G434-81

Sections 2.2.4, 4.3.1.4, and 4.3.4 address the size of the safety zone, how it would be established, and the potential impacts on marine traffic. The FSRU would be able to rotate 360° around the mooring turret. The safety zone would extend 500 m from the circle formed by the FSRU's stern, the outer edge of the facility, rotating around the mooring turret. See Figure 4.3-4 for an illustration of the potential safety zone and area to be avoided. The safety zone could not be made any larger because its size is governed by international law.

Tanker accidents

One of BHP's most recent maps[124] shows the FSRU as ~5 NM from the southbound lane, but it's actually 2.0 NM.

Collision analysis is missing. Tankers approaching from the south would cross the southbound lane into oncoming traffic. Tankers leaving to the north would cross the southbound lane. G434-82

The likelihood of tanker accidents is comparatively high. A tanker of the typical size that the Applicant would use takes 5 miles to come to a stop from the moment the captain "puts on the brakes."[125] With the FSRU being only 2 NM from the shipping lane, this produces an impossible "negative" margin of error. Granted, each tanker would be met by two tugboats; but in the foreseeable circumstance of high storm seas with one or more tugs becoming disabled, suddenly all bets would be off. The DEIS/R provides no such analysis. G434-83

A 2002 study performed by the interagency West Coast Offshore Vessel Traffic Risk Management Project ("Working Group") found this to be a high-risk traffic area,[126] and recommends that tankers stay at least 50 miles from shore, unless necessary.[127] The DEIS/R fails to address the Working Group study, despite it's having been highlighted in public scoping comments. G434-84

Accident risks associated with all types of tankers, irrespective of cargo type, should be assessed. These would include: various types of collision damage; damage associated with grounding; hazards of extreme sea and weather conditions, spills, etc. Such risks would be magnified to an unspecified degree by the unique hazards of LNG, such as metal brittlization and roll-over.

Also, tanker pilots are blocked from seeing less than 3/4 mile in front of them, and dense fogs are common in the area. Given that instruments are known to fail, and that small craft operators sometimes do not have adequate instrumentation, such impediments to visibility could foreseeably lead to collisions or near-miss accidents (e.g., man overboard).

A tanker anchorage plan is missing. The Applicant claims that none would be needed, because tankers would be monitored from 1,000 miles out.[128] But contingencies such as storms or *force majeure* suggest that traffic can't be controlled solely by regulating tankers' arrival time. Air traffic controllers know that. Tankers could "stack up" in a "holding pattern." G434-85

Tug anchorages been not been specified or mapped,[129] despite being required. G434-86

124 Dated 9.21.04 (297047_web.pdf).

125 Based on common knowledge, and noted at timrileylaw.com.

126 West Coast Offshore Vessel Traffic Risk Management Project Final Report 7/2002, at 3.

127 At 4.

128 "The LNG tankers will be monitored from a distance of at least 1,000 miles. If more than one LNG tanker would approach within a day of the other, one tanker would be asked to decrease its speed well in advance of arrival at the FSRU. There will be no need for temporary anchorage of LNG tankers." Matrix, at 14.

129 Matrix, at 16.

G434-82
Figure 4.3-2 depicts LNG carrier approach routes. Since the LNG carriers would neither enter nor cross the traffic separation scheme (TSS) under normal operating conditions, a vessel collision analysis was not conducted for LNG carriers calling at the proposed Project.

G434-83
As discussed in Section 4.2.7.3, BHP's Operations Manual would address every contingency which would include weather parameters dictating circumstances for off-loading. The Operations Manual must be approved by the USCG prior to commencement of operations.

LNG carriers would not attempt to dock in unsafe sea conditions and would neither cross nor enter the Santa Barbara Channel TSS, as identified in the Operations Manual. Section 4.3.1.4 identifies safety measures that would be used to avoid potential vessel accidents.

Sections 4.2.7, 4.2.9, and 4.3.4 and the Independent Risk Assessment (Appendix C1) contain discussions of the vessel collision analysis.

G434-84
Section 4.3.1.4 has been updated to include a discussion of this topic.

G434-85
Section 4.3.1.3 discusses this topic.

G434-86
The FSRU would be located in 2,900 feet of water (see Section 2.1). Tugs would not be able to anchor in that depth of water.

The Scoping Draft Application stated that three tugboats would be used per tanker. No explanation has been provided as to why this number was reduced to two.

G434-87

Storm conditions

The CEC cautions: "Oil tankers have been making deliveries at some near-shore mooring stations in California for many years. However, making deliveries miles offshore, totally unprotected from wind and storm conditions, would pose a different set of problems."[130] The Applicant has provided some discussion of 100-year storm conditions and the like, but has not specified how the FSRU and tankers would be designed to withstand extreme conditions – other than to say, in effect, "it will be designed for."[131] But without more detail about Project performance under extreme conditions, no real assessment of consequential impacts is possible.

G434-88

Relatedly, the Scoping Draft specified that the FSRU's would be rated to withstand 45-foot seas, which it cited as the "100-year return" maximum storm. Now the DEIS/R has specified the 100-year return wave height as being 24.6 ft.[132] What accounts for that significant change? Could it be that the Applicant determined that it would be impractical to build the FSRU to withstand 45-foot seas, so it found a way to come up with a smaller number? In any event, the seas at the site have approached 40+ feet many times in less than a 100 year period.

G434-89

And, given the anticipated increase in severity and frequency of storms associated with global climate change, how could one confidently assert that a 50-foot sea won't occur next winter, or 20 years from now? The DEIS/R does not address the implications of the scientifically-accepted theory that storms will likely increase in intensity and frequency in the coming decades.

G434-90

The Marine Operations Manual in the Application's "Confidential-Sensitive Information document" specifies when, due to weather or sea conditions, to "invoke a shutdown of the LNG transfer operations, departure of the tanker from the mooring, a prohibition on mooring, and a shutdown of all operations and evacuation of the port."[133] Who decides when and how these proprietary measures are implemented? That should be public knowledge, as it would inform assessment of risks associated with spills, collisions, drifting vessels, and the like.

G434-90.1

Disabled Tankers

The CEC cautions that "[s]hipping-related events which could result in LNG spills include collisions, groundings, navigational errors, and mechanical failures."[134] The DEIS/R does not address the potential risks of such events in which a tanker might become disabled or drift off course. This is a particularly egregious omission, given that tankers won't be present solely in

G434-91

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130 CEC LNG, at 13.

131 E.g., "the Applicant intends to design the FSRU and its mooring system based on 100-year wind/wave sea states with a 2-knot (2.3 mph, 1.03-meters per-second [m/s]) surface current originating from the most conservative direction." 4.1-9

132 Table 14.1-3.

133 Scoping draft EIS/EIR, 2.5.3.

134 CEC LNG, at 9.

G434-87
Section 4.3.1.3 has revised text concerning tugboat operations.

G434-88
See the response to Comment G434-49.

G434-89
See again the response to Comment G434-49.

G434-90
See again the response to Comment G434-49.

G434-90.1
Criteria for shut-down operations would be specified in the Operations Manual, which would be approved by the USCG (see Section 4.2.7.3).

G434-91
Impacts MT-3 and MT-4 in Section 4.3.4 address this topic.

the area of the FSRU, but will likely transit some portion of either or both the northern and southern coasts of California in their approaches to and departures from the area.

G434-91 cont'd

The DEIS/R doesn't analyze the potential frequency or impacts of other types of accidents which could cause a tanker to be disabled. Other types of tanker accidents include engine room fires, loss of containment, and temperature embrittlement from cargo spillage.[135]

G434-92

The DEIS/R provides no assessment of vessel seaworthiness. The Scoping Draft stated: "[The specified] vessel characteristics do not necessarily represent those vessels that will eventually be used, since vessels will be chartered according to shipping requirements and availability on the world market."[136] It went on to suggest that as long as a ship can dock with the FSRU, it's acceptable. This would appear to leave wide open the issue of whether a ships used are seaworthy, double-hulled, etc. Indeed, the DEIS/R admits that variously flagged vessels may be used – and specifically states that LNG may be imported from Korea, Indonesia or elsewhere, not just from Australia. Yet it does not specifically address the implied maritime safety risks.

G434-93

The Scoping Draft maintained that a risk analysis was performed that "included an assessment of the risk of impact from a vessel that has lost power and is drifting. The risk analysis determined that with a three nautical mile buffer the risk would be negligible."[137] Has this assessment somehow been updated, such that now a 2 NM buffer represents the threshold of insignificance? If not, the DEIS/R should be explaining how a 3 NM buffer is viable with the shipping lane being 2 NM from the FSRU.

G434-94

Moreover, that finding does not comport with that of the Working Group study.[138] Based on their calculations, a disabled tanker in this area could drift to shore in 5 hours – scarcely enough time for rescue tugs to be deployed.[139] Given that the prevailing winds and currents are towards the East, the disabled vessel would likely drift towards the Malibu shoreline. The DEIS/R does not address this.

G434-95

Meanwhile, State regulations only require a response-time of 18 hours: "Within 12 hours of notification that a vessel is disabled, or before a possible grounding (estimated as a function of worst-case wind drift data) a support vessel capable of stopping the vessel's drift must be on-scene. Within 18 hours of notification, equipment must be on-scene that is necessary to tow an incapacitated vessel to a safe haven."[140]

In brief, there are more variables to be controlled in preventing accidents, collisions and spills than it appears the Applicant would be willing or able to control.

135 CEC LNG, at 9.
136 Scoping draft EIS/EIR, 2.5.1.
137 Scoping draft EIS/EIR, 5.1.7.2.
138 West Coast Offshore Vessel Traffic Risk Management Project Final Report 7/2002.
139 Working Group, at 27.
140 Working Group, at 46.

G434-92
See the response to comment G434-91. Appendix C3 lists the incidents that have affected LNG carriers. Section 2.1 discusses the class certificates that would be required for all vessels. Section 4.3.1.4 discusses the measures that would be taken if a vessel became disabled.

It is more important to anticipate reasonably foreseeable problems and ensure that appropriate plans are in place to provide proper response actions.

G434-93
Section 2.1 discusses the certifications that would be required for all Project-related vessels.

G434-94
Sections 4.2.3, 4.2.6.1, and 4.2.7.6 discuss the Independent Risk Assessment (Appendix C1) and its findings. Section 4.3.1.4 discusses the safety zone and the Area to be Avoided.

G434-95
Section 4.3.1.4 discusses the recommendations of the West Coast Offshore Vessel Traffic Risk Management Project and provisions for disabled vessels. Section 4.2.7.6 addresses "Security Vulnerability Assessment and Hazard Identification."

PUBLIC SAFETY: HAZARDS AND RISKS

4.2-1 PDF 237

The Applicant, in its publicity and throughout much of the DEIS/R, variously states or suggests that the Project poses no significant threat to the public. But then "buried" on p. 883[141] it admits:

> "Although the probability of an offshore incident associated with the proposed Project is very low, should an incident occur, it would likely cause serious injury or fatality to members of the public."[142]

G434-96

This statement fairly speaks for itself – and for the Project on the whole. It suggests that whereas the probabilities of harms might be low (in some cases), the potential harms are great, and therefore significant. This must be considered within the context of the Applicant having made no reasonable case for the "No-Action Alternative."

Terrorism and related threats unaddressed(?)

Because the analysis of terrorist strike threat is classified, the public cannot know how adequately it might (or might not) have been addressed. Following are several considerations which have not been raised in public discussion, so might well still be unassessed.

If a credible threat of terrorism were received (through intelligence agencies), the warning would have to be received approximately four days before the attack were to occur, if the possibility of explosion were to be eliminated. This is because it would take 92 hours to substantially empty the Moss tanks, with the FSRU running at peak capacity.[143] Now, the warning period could be considerably shortened if all or most of the LNG were vented directly to the air. However, and in any case, the DEIS/R provides no direct discussion of either the advance time required to brace against a attack nor the potential impacts of a wholesale, rapid venting of the Moss tanks. How quickly could the "cold venting" process[144] be achieved?

G434-97

The FSRU mooring assembly represents a potential weak point with respect to terror attack. If a kamikaze boat were to target it in an attack similar to the one made upon the USS Cole, the FSRU could be set adrift – a single, accurately targeted explosion could sever the four flexible risers and all nine mooring cables. If only one tug were present on site – or if tug(s) were also targeted in the attack – the FSRU could drift towards shore. And the response time for additional tug(s) to be deployed could foreseeably be insufficient to prevent the FSRU from grounding (see *Disabled tankers*, below).

141 of the PDF; the hard copy page is 4.20-13.
142 4.20-13.
143 2-15.
144 Described at 2-17.

G434-96
The EIS/EIR identifies unavoidable significant (Class I) public safety impacts. The Administrator of MARAD under the authority of the Deep Water Port Act, the California State Lands Commission, and the Governor of California have to balance the benefits of the Project against its unavoidable environmental risks. In accordance with the State CEQA Guidelines § 15093, the CSLC would have to make a Statement of Overriding Considerations addressing Class I impacts prior to approval of the Project.

G434-97
Section 4.2.6.1 addresses the risk of terrorist attack. The Independent Risk Assessment (Appendix C1) analyzes the scenario of a breach of the Moss tanks. Section 4.2.7.6 under "2006 Independent Risk Assessment" and Impact PS-2 discuss the Independent Risk Assessment.

LNG accidents

As a threshold matter, there is a serious question as to whether the Hazard Identification and Security Vulnerability Assessment might have been substantially incomplete and/or improperly biased, for the simple reason that its basic set of potential scenarios were identified during anecdotal workshop conditions, and arrived at by verbal consensus. The DEIS/R describes the process as follows:

> "The Applicant described specific systems and operations of the proposed facility to familiarize the workshop participants and was then excused from further participation in the workshop sessions. The workshop leaders helped the group to systematically identify possible accident scenarios. The consensus listing of accident scenarios was recorded in a register, which formed the basis for the Independent Risk Assessment for the proposed LNG DWP. The workshop team."[145]

G434-98

Such a setting could not have allowed sufficient conditions for reflection and considered scientific and technical review. Because the process was both "led" and dependent on consensus, there would necessarily have been substantial (conscious or unconscious) motivation for participants to, in effect, tell the workshop leaders what they wanted to hear – that's how human nature works. Even assuming the Hazard and Security Assessment proceeded to a more a rigorous analytical stage, the initial assumptions were already set. These issues should have been subject to a more formal hazard identification process, in which multiple analysts would each have had the opportunity to exercise independent judgment, speculation, hypothesis formulation and analysis. Only after that point should the list of potential scenarios been compiled.

Vessel and aircraft collisions

Incomplete analysis of accidents involving collision of a tanker with the FSRU (or LNG tanker) has been provided.

G434-99

No assessment is given for the potential impact that one of the Navy's 24 annual "low-level supersonic flight tests"[146] could have if it were to strike the FSRU and/or an LNG tanker. These flights occur both in the Pt. Mugu Sea Range and "in adjacent airspace off the coast of California." The FSRU, being only 2 NM from the boundary of the Sea Range[147] is in *adjacent air space*. In addition, it's situated within a "nook" in the Sea Range: South of the FSRU, the Range extends eastward to the tip of Catalina Island (See Figure 4.2.3), such that planes flying between Pt. Mugu and the SE portions of the Sea Range could be regularly expected to "cut the corner," directly over the FSRU.

G434-100

Surely an accidental airstrike would be unlikely, but it is reasonably foreseeable – several fatal Navy jet accidents occur off the coast of California each year. [And just this evening, I watched from my clifftop home (elevation 230 ft.) as three Navy fighter planes shot past in tight

145 4.2-13.

146 4.3-4.

147 Notwithstanding BHPB's incorrect assertion that it would be 2.4 NM (noted above in section, *Factual inconsistencies and distortions*).

G434-98
The Independent Risk Assessment (IRA) has been updated since issuance of the October 2004 Draft EIS/EIR. The lead agencies directed the preparation of the current IRA, and the U.S. Department of Energy's Sandia National Laboratories independently reviewed it. See Section 4.2, Appendix C1, and Appendix C2 for additional information on third-party verification of the IRA.

G434-99
in Sections 4.2.2, 4.2.6, and 4.2.7, and Appendix C1 provide additional information on this topic.

G434-100
Table 4.2-2 identifies similar accidents.

formation, no more than 50 feet above the ocean and within 200 ft. of the row of beach houses below me!] A low-flying Navy jet could impact all three Moss tanks simultaneously, possibly at supersonic speed. Presumably, in the classified security analysis, the possibility of a terrorist making a *kamikaze* run with a small private plane was considered; but how much more damage could be caused by a supersonic jet impact?

G434-100 cont'd

HAZID analysis

In assessments of potential explosions and blast radius, the models assume a maximum of three Moss tanks. However, tankers would be frequently berthed directly alongside the FSRU, and they themselves generally have three Moss tanks. Thus, the DEIS/R should have used six Moss tanks as the basis for analysis. This would represent a hugely significant difference with respect to the size of the exclusion zone and proximity to the shipping lane, among other implications.

A six-tank explosion scenario might even be more likely than a three-tank scenario, because:

- One plausible explosion scenario would involve the FSRU being rammed by a tanker, putting at risk the cargoes of both;
- Any terrorist worth his salt would time his attack to coincide with when a tanker was berthed alongside.

G434-101

The DEIS/R claims that the risks of explosion or other serious accidents involving combustion would be comparable to those of shore-based facilities (small comfort). In contrast, The CEC finds that "most analysts conclude that the risks associated with shipping, loading, and off-loading LNG are much greater than those associated with land-based storage facilities."[148] The CEC also notes that Moss tanks are less safe than all of three different types of tanks used on land.[149] The DEIS/R has some explaining to do in this regard.

G434-102

HAZID analysis incorrectly assumes zero or near-zero wind speed. But a some greater speed of the prevailing onshore winds could spread a cloud towards shore, or spread the LNG layer on the water further before ignition densities were reached. (Higher wind speeds would also exacerbate a drifting tanker situation, limiting response time in the case of a tanker drifting towards the FSRU, or either FSRU or tanker drifting towards shore.)

G434-103

The hole size of a rupture is modeled only at sizes of 50 mm, and in one case, 500 mm.[150] Yet any significant impact or failure is likely to result in a larger hole size, insofar as post-impact gas pressures are likely to widen the crack. This is particularly foreseeable because Moss tanks are built of aluminum, which has a high propensity to tear compared to other metals. Modeling should include more realistic hole size(s).

G434-104

The Analysis of explosions is incomplete – both worldwide, and on-site. Some accidents from the past four years are omitted.

G434-105

[148] CEC LNG, at 3.
[149] CEC LNG, at 4.
[150] Table V-1.

G434-101
Section 4.2.3 explains that the amount of LNG that would be released could never exceed the total storage capacity of the FSRU. Specifically, prior to the arrival of an LNG carrier delivering LNG to the FSRU, the FSRU would have to send enough regasified LNG to shore via the offshore pipelines to make room for the new delivery.

G434-102
The cited document was consulted in the analysis of offshore LNG risks, see Section 4.2.10.

G434-103
The Independent Risk Assessment considers wind speed. The revised "2006 Independent Risk Assessment" in Section 4.2.7.6 discusses the selection of wind speeds, drifting of the FSRU, and other public safety impacts involving offshore facilities.

G434-104
Hole size modeling was defined by Sandia National Laboratories and validated in the collision analysis (Appendix D of Appendix C1).

G434-105
Appendix C3 lists LNG carrier accidents.

The DEIS/R claims that the maximum foreseeable radius of an LNG blast would be 1.4 NM, but BHPB has publicly stated it would be 5 miles.[151] And *more-credible* scientists[152] suggest it could be double that.

G434-106

Emergency venting

With regard to emergency venting of LNG (as vapor) via the cold stack, The application states: "The cold stack height, pending final design, will be approximately 250 feet above the water line, and approximately 80 feet above the top of the storage tanks, elevated personnel walkway and elevated piping along the tops of the tanks."[153] Is that an adequate margin for error with respect to volume and pressure of gas emitted in an emergency incident? (I don't see it in the DEIS/R.) Is 80 feet above the tanks high enough that the oxygen-gas mix at ship level -- where a spark might occur -- would *never* be within the 5-15% explosive range?

G434-107

What would happen if still-cold gas were to escape -- wouldn't it descend upon the deck? The CEC cautions that, "[o]n contact with certain metals, such as ship decks, LNG can cause immediate cracking."[154]

G434-108

Abnormal venting

The California Energy Commission points out that "if LNG stratifies into layers of different densities within a storage tank, a phenomenon called 'rollover' could occur. With 'rollover,' pressures within the tank could rise to excessive levels, and, without properly operating safety-vent valves, pressures could rise to levels that would cause structural damage."[155]

G434-109

In sea-born tanks, there is both the opportunity for stratification occasioned by long-duration tanker voyages, and pitch/yaw movements induced by waves. How would rollover be prevented under such conditions?

G434-110

Other onboard hazards

The DEIS/R does not address the fact that insulation used in the FSRU is highly flammable.

G434-111

Note that in the case of vessel fires, federal regulations require a response time of 24 hours for arrival of firefighting personnel: "US federal vessel response plan regulations, 33 CFR 155.1050(k), require tank vessel owners and operators to identify and ensure availability of salvage and marine firefighting resources, with personnel and equipment that can be deployed to a port nearest to the vessel's operating area within 24 hours."[156] Clearly, that timeline would be seriously inadequate, given that a disabled vessel could drift to the Malibu shore in five hours

G434-112

151 Commentary in Ventura Star, March 28, 2004.
152 Including but not limited to Jerry Havens and James Fay.
153 Appli., 2.5.5.3.3.
154 CEC LNG, at 2.
155 CEC LNG, at 5.
156 Working Group, at 44.

G434-106
Assuming ignition of the gas would occur at the time of the release, the Independent Risk Assessment (IRA, Appendix C1) calculated that a pool fire could affect an area of about 1.7 NM from the FSRU. The IRA also determined that the consequences of the worst credible accident involving a vapor cloud fire would be more than 5.7 NM from shore at the closest point.

G434-107
Section 2.2.2.3 addresses this topic. Section 2.2.2.5 contains additional information on emergency depressurizing and venting. As described in Section 4.2.7.1 LNG is flammable, not explosive, in concentrations between 15 percent and 5 percent. A cloud of natural gas has not been shown to burn or explode if it is not confined. Since only natural gas would be released through the cold stack and natural gas is buoyant, it would rise above the FSRU.

G434-108
See Section 4.2.3.1 and 3.4 of Appendix C1.

G434-109
Section 2.2.2.5 contains information on the FSRU's venting system. Appendix A of the Independent Risk Assessment (Appendix C1) contains information on potential failure of the venting system.

G434-110
As described in the cited CEC document, modern LNG storage tanks contain instruments to monitor for this condition and LNG is recirculated. LNG carriers are also equipped with vents.

G434-111
Mitigation Measure PS-1e in Section 4.2.7.6 addresses this topic. In addition, the marine safety and security requirements cited in Appendix C3, under the topic of secondary containment and thermal management, identifies International Gas Carrier (IGC) Code requirements concerning insulation.

G434-112
Section 4.2.4.2 addresses offshore emergency response. Section 4.2.7.6 discusses offshore public safety impacts, including drifting of the FSRU.

(see *Disabled Tankers*, above). The DEIS/R provides no assessment of this apparently unmitigable significant risk.

G434-112 cont'd

SEISMIC HAZARDS ("GEOLOGIC RESOURCES")

4.11-1, PDF 637

The CEC finds that "[t]ypical earthquake and geologic hazards include potential for fault-related, ground-surface rupture; intense ground shaking; adverse foundational conditions, such as soil liquefaction and settlement; slope instability; and tsunamis… an LNG facility cannot be sited in a major fault zone because of potential damage from surface rupture."[157] Yet that is exactly what the Applicant proposes.

G434-113

Missing earthquake fault data

The draft Application stated that "The Project will lie within an area marked by intense deformation and tectonic activity.…There are two major fault systems that are buried under the Hueneme fan and run across the pipeline route."[158] The current Report's inventory of relevant fault systems is improved, but much data remains omitted. Now, the Applicant does note five of the active faults that underlie or are near the offshore pipeline route.[159] But it still slights or omits discussion of at least several significant faults.

The Anacapa fault is called inactive,[160] but it's produced at least five shocks around 6.0.

The Sycamore Fault, which approaches or underlies the route near the top of the Hueneme-Mugu slope (as shown in the fault map, Figure 4.11-6), remains unaddressed. The fault map also omits the clear traces of faulting across the area of the Hueneme-Mugu slope; the omission in this area would be more apparent if the map showed the entire region extending to the west of its coverage.

G434-114

Also omitted is the Santa Cruz-Catalina Ridge Fault, just beyond the Report map's coverage. This fault is situated approximately 7 miles south of the FSRU, and roughly parallels the coastline. (My FIGURE 3.) In 1981, this fault generated a quake in the 6-6.5 range. The Report omits this fault and others by ignoring some recent credible research, notably a 2002 University of California study sponsored by the USGS, "Structure and kinematics along the thrust front of the Transverse Ranges: 3D digital mapping of active faults in Santa Monica Bay using reflection, well, and earthquake data."[161] Instead, much of the analysis of seismic characteristics of the area

G434-115

157 CEC LNG, at 13, 14.

158 Scoping draft EIS/EIR, 2.3.3.

159 These faults are named: Malibu Coast, Anacapa/Dume, Pitas Point-Ventura, Oak Ridge, and Santa Cruz Island. 4.11-8.

160 Matrix, at 17.

161 "Mapped faults include the E-W Dume fault, a large buried fault beneath it, the Malibu Coast fault above it, and the young NW-SE surface San Pedro Basin fault. The Dume fault is probably directly connected to the Santa Monica fault and the combined system has predominantly left-horizontal slip in its ENE coastal segment." Collaboration between University of California, Santa Barbara and Columbia University. USDI/USGS 02HQGR0013 (UCSB) USDI/USGS 02HQGR0007 (Columbia) Christopher C. Sorlien and Marc J. Kamerling*, Institute for Crustal Studies, University of

G434-113

Section 4.11.1.2 states, "Some of the major active or potentially active faults include the ... Anacapa/Dume Fault..." Table 4.11-1 and 4.11-2 list four earthquakes between magnitude 5 and 6 attributed to the Anacapa/Dume Fault (see Appendices J1 and J2).

G434-114

The faults shown on Figure 4.11-6, including the Sycamore Fault, are not all considered active or a threat. Table 4.11-1 lists earthquakes greater than magnitude (M) 4.5 within 25 miles of the Project and their associated faults. Table 4.11-2 lists all nearby significant (>M 5.5) recorded earthquakes between 1812 and 2000; these are also shown on Figure 4.11-7. These two tables and Figures 4.11-6 and 4.11-7 also reference all of the nearby earthquakes and named faults that intersect the Project that are identified by the USGS in a study done specifically for the Project in 2004 (see Appendix J1).

The USGS study included faults in the National Seismic Hazard Maps database that are the basis for seismic provisions in the International Building Code. The faults identified by the USGS are those with evidence of fault slip during the past 1.6 million years, as well as established fault slip or a history of past earthquakes. The Sycamore Fault is not listed on these two tables and is therefore not considered active or a threat.

G434-115

Tables 4.11-1 and 4.11-2 list the Santa Cruz-Catalina Escarpment as the fault associated with a magnitude 5.9 earthquake in 1981. The fault is shown as #25 on Table 4.11-2 and Figure 4.11-7.

relies on citations from the 70's and 80's, even though more modern research is available, especially after the 1994 Northridge earthquake.

G434-115 cont'd

The UC/USGS study also shows several blind thrust faults in the immediate region of the off-shore pipeline (dotted lines in FIGURE 3), that are ignored in the Report. Blind thrust faults are especially significant in that, whereas they tend to release energy less frequently than surface faults, they do so with *greater* destructive energy.

G434-116

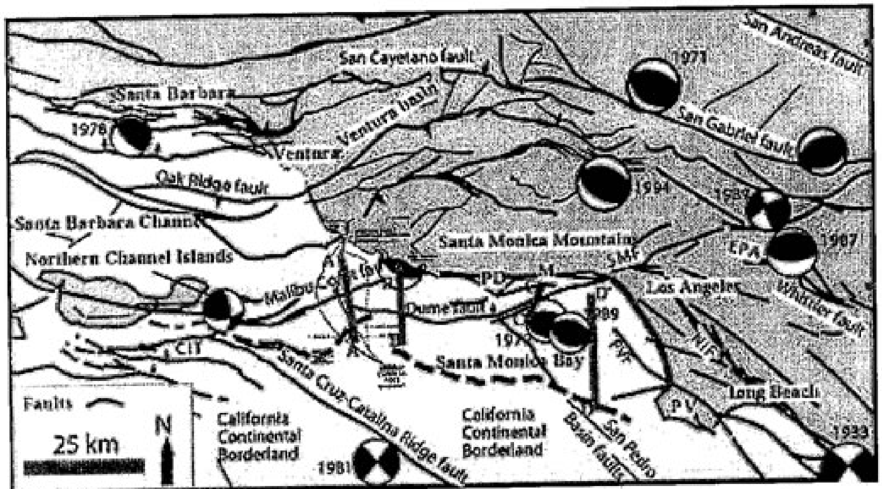

FIGURE 3: Major known active quake faults coincident with, and proximate to, the project site. BHP Billiton LNG's own project map overlaid in red; base map is from U.C./USGS study, 2002. "Beachballs" show locations of only a few representative large quakes.

Moreover, the Report cites just three faults in the vicinity of the Santa Clarita Pipeline Loop (the Holser, Simi-Santa Rosa, and San Gabriel Faults). But Figure 4.11-5 shows at least six nearby faults (some on the map are unnamed). And, given the limited resolution of the map, additional significant fault features are likely not shown.

G434-117

California, Santa Barbara, California, 93106 Leonardo Seeber, Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York ICS Telephone (805)-893-8231, ICS FAX (805)-893-8649 Sorlien email: chris@quake.crustal.ucsb.edu, Sorlien URL: www.crustal.ucsb.edu/~chris *Kamerling is now at Venoco Oil Company, Santa Barbara, California. Research supported by the U. S. Geological Survey (USGS), Department of the Interior, under USGS award number 02HQGR0013. http://erp-web.er.usgs.gov/reports/annsum/vol44/sc/02HQGR0013.htm

G434-116
The faults shown in the EIS/EIR maps are major active faults collected from several sources. A blind fault simply means that the fault does not reach the land surface, though it may cause uplift. Table 4.11-2 lists the recorded earthquakes with magnitudes greater than 5.5 within 25 miles or large quakes within approximately 80 miles of the Project. The Northridge Fault is a blind thrust fault. The 1994 Northridge Quake was not as strong as many other quakes that occurred in the area. Therefore, blind thrust faults are not necessarily more destructive than other faults.

The natural gas pipelines will be designed for the maximum credible seismic displacement. Nonlinear finite element analyses will be used to model the pipe/soil interface and the fault displacements

G434-117
Not all faults shown on the maps are considered active, nor are all small faults named. Some may be considered splinter faults connected with a larger fault system. The named faults discussed in the EIS/EIR are those that are considered active.

The Report admits to uncertainty about how close the San Gabriel Fault approaches the Line 225 Pipeline Loop, in several locations.[162] It suggests that geotechnical investigation must be performed; but without such investigations having been done, the fault data remains significantly incomplete in these important locations.

G434-118

In sum, the DEIS/R recognizes only eight of the fifteen (or likely more) active faults in the immediate Project area. This means that its assessment of seismic risk is necessarily incomplete (in addition to its other shortcomings).

G434-119

Incomplete assessment of seismic hazards

The draft Application stated that "pipeline routing should avoid directly crossing active faults and areas of historic slide activity."[163] In light of the above, that would be impossible.

The DEIS/R misleadingly states that "the State of California considers a fault segment historically active if [surface rupture has occurred in] approximately the last 200 years."[164] More accurately it states, "a fault that shows evidence of movement within Holocene time (approximately 11,000 years) is defined as active."[165] Indeed, the CEC points out the requisite seismic safety test: "U.S. Department of Transportation (DOT) regulations require that LNG facilities be designed and built to withstand earthquake ground motion with a 1-in-10,000-year exceedance without loss of structural or functional integrity."[166]

G434-120

The record of historical earthquakes near the project site[167] is both incomplete and muddled. Quakes on some faults near the site are omitted (see *Missing earthquake fault data*, above). Some distance references to the *offshore* pipeline are misidentified or misleading. For instance, the 1981 quake on the Santa Cruz-Catalina Fault (map no. 25) is reported as being 14 miles "S of FPSU" [sic]; that may be true, but it ignores that the fault itself runs within ~7 miles of the FSRU. By reporting only the distances to *epicenters* of past quakes, the report implies that potential hazards are further away than they actually are.

G434-121

At least several magnitudes of past quakes are understated. For instance, the 1857 Ft. Tejon quake (Map no. 1) is commonly cited in the literature as being a M ≤ 8.5, yet here it has been labeled M 7.9. The 1981 quake on the Santa Cruz-Catalina Fault (map no. 25) is reported as M 5.9, but it appears on the USGS map above as being *at least* M 6.0.

G434-122

The DEIS/R claims that the USGS estimates a probability of "35 percent for an earthquake of M 6.5 or larger within 30 miles (48 km) of the [FSRU] over the next 30 years."[168] Yet examination of Tables 4.11-1 and 4.11-2 shows that a quake of M >6.0 has occurred in that area on

G434-123

162 4.11-22.
163 Scoping draft EIS/EIR, 5.1.3.
164 4.11-8.
165 *Id.*
166 CEC LNG, at 14.
167 Tables 4.11-1 and 4.11-2.
168 4.11-21.

G434-118
Section 4.11.1.3 addresses this topic and includes additional information.

G434-119
Table 4.11-1 lists ten active faults. It is not possible to assign a specific fault to some earthquakes that occurred prior to the widespread use of siesmographs. The tables in Section 4.11 list all recorded earthquakes over the last 190 years that are over the stated estimated magnitudes and within the stated distance. Not all faultlines shown on maps are active or major faults.

G434-120
Table 4.11-1 has been retitled to clarify the difference between it and Table 4.11-2. Table 4.11-1 lists earthquakes greater than magnitude (M) 4.5 within 25 miles of the project and their associated faults. Table 4.11-2 lists all nearby significant (>M 5.5) recorded earthquakes between 1812 and 2000; these are also shown on Figure 4.11-7.

These two tables and Figures 4.11-6 and 4.11-7 also reference all of the nearby earthquakes and named faults that intersect the project that are identified by the USGS in a study done specifically for the Project in 2004 (see Appendix J1). The USGS study included faults in the National Seismic Hazard Maps database that are the basis for seismic provisions in the International Building Code. The faults identified by the USGS are those with evidence of fault slip during the past 1.6 million years, as well as established fault slip or a history of past earthquakes.

G434-121
Plotting the distance to the epicenter is the standard practice in reports and literature.

G434-122
It is common to have several different estimates of earthquake magnitude for the same quake. This is particularly true for quakes that occurred before there were seismographs and a scale, for example the 1857 Ft. Tejon quake.

Table 4.11-1 lists the highest magnitude for each quake listed in several sources. Table 4.11-2 lists the magnitude presented in the referenced report.

G434-123
The document accurately states what the USGS reported, which was that there is 35 percent chance of a M 6.5 or larger quake

within 30 miles of the FSRU over the next 30 years. Table 4.11-2 and Figure 4.11-7 show no historic earthquakes >M 6.5 within 30 miles of the FPSU and four earthquakes >M 6 over the last 190 years within 30 miles of the FSRU. The USGS report is included in Appendix J1.

average every ~15 years in the historical period. This suggests that the probability of another comparable quake in the next 30 years is far greater than 35 percent. Given the paucity of data presented, one cannot specify an exact percentage; but in qualitative terms, one can confidently say that a nearby quake in the range of 6-6.5 or greater is *extremely likely* during the working lifespan of the FSRU.

G434-123 cont'd

Note that the Report does admit that there is a 60 percent likelihood that such a large quake will occur at some *onshore* pipeline locations; and that there is a significant likelihood of quakes M >8.0 occurring on the San Andreas Fault within 20 miles of the onshore pipeline.[169]

Incomplete assessment of pipeline risks

G434-124

The pipeline would cross active quake faults; however, the DEIS/R dismisses the risks with rationales that are frequently unsubstantiated. For instance, the applicant states (incorrectly) that the crossed portion of the Malibu fault is inactive. Nonetheless, it elsewhere admits, "Historical displacement is…not a direct indicator of future displacements."[170] Indeed, activity on one portion *necessarily* increases stress elsewhere along a fault.

As faults are known to produce instantaneous lateral displacements of 20 or more feet,[171] one cannot say that a pipeline of any known type of design would necessarily survive intact. Given the large amount of gas in the 21-mile pipelines, a rupture could produce a huge cloud, *even if all auto shutoffs were switched instantly*.[172]

G434-124.1

Now that the pipeline design has been changed from one pipe of 30" diameter to two pipes of 24" diameter, the maximum amount of gas released if only one pipe were to fail would be somewhat reduced. However, a quake strong enough to rupture one pipe could plausibly rupture both, given that a rupture zone could be substantially longer than the 100 ft. width between the two pipelines. With two ruptured pipelines, the maximum potential gas release has now increased substantially, from 546,874 cu.ft. (one 30" pipe) to 700,000 cu.ft (two 24" pipes).[173] The DEIS/R does not appear to acknowledge any changes in potential impacts associated with this increase.

G434-125

Relatedly, the DEIS/R provides no analysis of how the reduction in pipe diameter might affect overall pipe strength. A smaller pipeline would be more susceptible to breakage, because a

169 4.11-21.

170 Comment Matrix, at 18.

171 See 4.11-32.

172 "[P]pipeline length may pose a [significant] risk if a natural gas release occurs because the line would hold a [great] volume of gas that could escape." Scoping draft EIS/EIR, 5.1.3.

173 Volume of gas in one pipeline cylinder, of 1.25 ft. radius:

Pi	* Rsquared	* Length	
3.1416	* 1.5625	* 111,408 ft.	= 546,874 cu. ft.

Volume of gas in two pipeline cylinders of 1 ft. radius:

Pi	* Rsquared	* Length	
3.1416	* 1	* 111,408 ft.	* 2 pipes = 699,999 cu. ft.

G434-124
Table 4.11.1 lists the Malibu Coast Fault as an active or potentially active fault.

G434-125
Section 2.3.1 contains information on the design characteristics of the offshore pipelines, which would be designed in consideration of all applicable standards. Section 4.2.8.2 and Table 4.2-14 discuss the major laws and regulatory requirements (state and federal) to which pipelines must comply.

The pipeline stress analysis would consider all of the applied loads and displacements and the pipeline would be sized (thickness, steel grade, etc.) to meet all design loads. If a pipeline has a reduced diameter does not mean that it is weaker. It could be much stronger, depending on thickness or material grade.

smaller diameter has a tighter curvature, which implies reduced tensile strength of material in response to pressure loading. (Also, the pipeline width is specified as 2.2 cm;[174] this thinness would appear to be readily puncturable by a dropped anchor.)

G434-125 cont'd

Arco's oil pipeline No. 1 was irreparably damaged by the 1994 Northridge earthquake.[175] What was its magnitude and how close to the epicenter was the pipeline? The applicant still has not answered this question raised in response to the Scoping Draft.

Meanwhile, no analysis has been presented regarding the extent to which offshore pipelines that are "pre-stressed" by water pressure at depth might be more susceptible to failure:

G434-126

- At a depth of 884 meters, pipes would be subject to water pressures of over 1,300 PSI – more than half a ton per square inch.[176] Over the 24-inch width of one pipeline, that would be 31,200 pounds (15.6 tons) for every inch of pipeline length, or 374,400 pounds (187.2 tons) for every foot of pipeline length.[177]
- The pipelines would cross the known active Anacapa-Dume Fault at a depth of approximately 670 meters.[178] There, water pressure is >1,000 PSI, or ≅ 300,000 pounds (150 tons) per foot of pipe length.

The DEIS/R suggests[179] that seismic forces acting on the offshore pipelines would be insignificant because the pipeline would overlay the seabed (rather than being embedded in it); that a freely overlaying pipeline would be able to accommodate some degree of ground fracture beneath it without any adverse affect. However, at the depths where the pipelines would cross known active faults, water pressures would be so strong as to effectively "marry" the pipeline to the seabed. Were a rupture to occur, the portions of pipe on either side would very likely be shifted – and snapped – precisely along with the opposing slide blocks. (By analogy, consider the act of snapping a branch by stepping on one end and yanking up the other: if one's foot slides off – no downward pressure – the branch will be lifted up undamaged; but if one's foot is firmly holding down the branch when one yanks upward, the branch will snap.)

G434-127

Relatedly, no analysis has been provided regarding the potential effects of (repeatedly) altering the pressure inside the pipelines, for instance, during occasions of hydrostatic flushing or "intelligent pigging." Might sudden changes in internal pressure have magnified effects on pipes' tensile strength, given the existence of extreme external pressures?

G434-128

174 2-25.

175 *California's Pacific Pipeline wins key approvals*, Oil & Gas Journal, July 15, 1996, at 20.

176 Given that atmospheric pressure at sea level is 14.7 PSI, and that seawater pressure increases at the rate of one atmosphere (~15) per every 10 meters of depth.

177 Granted, the gas inside the pipe would provide some counteracting pressure, but of an amount negligible compared to the outside pressure.

178 Based on comparison of Local Offshore Geologic Map (Fig. 4.11-6) and Seabed Slope Gradients map (Fig. 4.11-2).

179 "The Applicant shall install the offshore pipeline directly on the seabed surface. This shall allow enhanced flexibility of the pipeline, when compared to a buried pipeline, to deal with movement caused by fault rupture." 4.11-33.

G434-126
Hydrostatic pressure (at depth) is considered as a design load for a pipeline, along with the internal pressure. The underwater pipelines would not be "pre-stressed" by water pressure. Although a column of water exerts a downward force, the pressure acting against a submerged object at a given depth is very nearly equal in all directions and exerts only a negligible downward force. The only significant downward force acting on the pipeline is its own weight and the weight of the fluid it contains.

The pipeline is not automatically "married" to the seafloor, the hydrostatic pressure exists all around the pipeline, buoyancy is also incorporated into the design criteria.

Table 4.2-14 provides the major laws and state and federal regulatory requirements to which pipelines much comply.

G434-127
See the response to Comment G434-126.

G434-128
Section 2.3.1 addresses this topic.

BHPB claims that sediment covering one fault would mitigate against ruptures.[180] But at the same time it would stiffen the pipeline (and contribute somewhat to increased external pressure), such that ground rupture could more likely produce pipeline rupture, rather than allowing the pipeline to flex or slide on top of the seabed. G434-129

Meanwhile, it is well established that sedimentary areas represent an elevated risk of liquefaction and subsidence. So in cases where sedimentation on or around the pipeline does not increase rigidity and thereby the "snapability" of the pipe, it's propensity to liquefaction and subsidence could well induce the pipeline to move more than it otherwise would, there by also increasing the risk of rupture. Either way, sedimentation is a complicating risk factor that has not been adequately addressed; significant discrepancies remain regarding the quantity, location and character of sedimentation.[181] The Applicant does not even know how thick are the sediments underlying the pipeline.[182] G434-130

Known significant seismic hazards

Notwithstanding the DEIS/R's incomplete presentation of seismic hazards, it does recognize a wide variety of *known significant* seismic hazards throughout the Project area. However, many of these appear to be substantially unmitigated or unmitigable (as discussed further below). Here are just a few representative examples of such known hazards: G434-131

- "Periodic earthquakes accompanied by surface displacement can be expected during the Project life."[183]
- "The effects of strong ground shaking, mass movement, and fault rupture are of primary concern."[184]
- "Damage to pipelines and/or other facilities could occur due to mass movement of soil. Mass movement includes landslides, liquefaction, subsidence, sand migration, or turbidity currents. The ground shaking from an earthquake could cause loose sediments found on slopes to move. Onshore, seismic hazard zone maps show that the Center Road Pipeline and alternate routes occur almost entirely within areas that may be subject to liquefaction (CGS 2004). The Line 225 Pipeline Loop encounters areas that are considered as having landslide potential in MP 0 to 3, and over the last 0.5 mile (0.8 km) the areas in-between are considered as having liquefaction potential."[185]

180 "Although the Anacapa Dume Fault and Malibu Coast Fault, which may represent either active or potentially active faults, intersect the Project pipeline, the faults are buried by thick Hueneme Fan sediments and it appears very unlikely that ground ruptures would occur as a result of fault movement in the vicinity of the Project pipeline." Matrix, at 18.

181 Matrix, at 18.

182 "perhaps less than 3 feet of holocene mud" 4.11-7. In addition, this is overlain by an unknown extent of alluvium and detritus.

183 4.11-21.

184 4.11-21.

185 4.11-22-3.

G434-129
Applicant Measure GEO-3b in Section 4.11.4 addresses this topic.

G434-130
Numerous cores have been taken along the proposed offshore route. These cores are the basis for the statement that the Project pipelines are expected to rest on less than 3 feet [0.9 m] of Holocene mud (see Section 4.11.1.1). Holocene means recent, i.e., the 12,000 years since the last ice age. There are no other overlaying sediments. Underneath this mud is a harder substrate that resists coring. This thin veneer of sediments means that there is, in general, very little deposition along the marine portion of the proposed Project route.

As discussed in Section 4.11.4, under MM GEO-3c, additional marine geophysical and geotechnical studies would be conducted for the proposed Project once the license is obtained.

G434-131
The EIS/EIR describes potential seismic hazards. Where potential impacts may be significant, mitigation measures have been proposed to reduce potential risks associated with construction and/or operation of the proposed Project. Section 4.2.4 identifies government agencies that are responsible for seismic and other safety measures. Section 4.11.4 contains revised text on geological impacts and mitigation measures.

- "The area considered to have the highest liquefaction potential along the offshore part of the Project is on the shallow shelf near the onshore landing. It is in that location that the thickest deposits of potentially liquefiable material are expected." (Fugro March 2004).[186]
- "Most of the onshore parts of the pipelines are in areas that are considered to have liquefaction potential due to the granular soils and shallow water table."[187]
- "Results of a study by Sprotte and Johnson (1976, as reported by Entrix, May 2004) indicate that the potential for seismically induced differential settlement of Holocene sediments in the Project area is high."[188]
- "A large area of the Oxnard Plain has experienced subsidence.... [S]ubsidence will probably continue and the rate and amount could increase if extraction of fluids from the area is maintained at its current level, or increases."[189]
- Materials underlying much of the pipeline route are subject to liquefaction. These may include alluvium, detritus, and "perhaps less than 3 feet of Holocene mud directly overlying…clay, sand, silt and small amounts of conglomerates…[and] Hueneme Fan deposits."[190] But their composition and depth is uncertain, so the liquefaction hazard remains unidentified.

G434-131 cont'd

A full listing of such examples would run many pages. Moreover, admissions made in the scoping draft still apply, such as that there is

> "a high seismic risk…severe ground shaking could potentially impact the Project pipeline…hazards include: slope failure, liquefaction of sediments and soils due to the presence of loose sandy material along the offshore portion of the Project; and the possible presence of shallow gas seeps that could potentially damage the pipeline."[191]

The significance of the examples above is actually acknowledged in the DEIS/R, in that they (individually or collectively) meet virtually all of the "significance criteria" that the Applicant has derived from CEQA Guidelines.[192] The criteria met (4.11-29) include:

G434-132

- Exposes people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault,
  - Strong seismic ground shaking,
  - Seismic-related ground failure, including liquefaction, or

186 4.11-23.
187 4.11-23.
188 4.11-24.
189 4.11-24.
190 4.11-7.
191 Scoping draft EIS/EIR, 5.2.1.
192 4.11-28,29.

G434-132
Section 4.11.3 presents significance criteria, which are based on the State CEQA Guidelines. Section 4.11.4 identifies impacts associated with geological resources and hazards and presents mitigation measures to reduce potential impacts in cases where significance criteria are met.

- Causes severe damage or destruction to one or more Project components as a direct consequence of a geologic event;

G434-132 cont'd

- Damages a pipeline due to landslide, lateral spreading, subsidence, liquefaction or collapse as a result of locating the Project on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project;
- Releases toxic or other damaging material into the environment as a result of a geologic event;
- Releases toxic or other damaging material into the environment as a result of installation activities release of drilling muds during horizontal directional drilling (HDD);
- Exposes people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving inundation by seiche, tsunami, or mudflow; landslides; flooding;
- Deteriorates structural components of the port, subsea pipeline, terrestrial pipeline, or other land-based facilities due to corrosion, weathering, fatigue, or erosion that could reduce structural stability; and/or
- Damages pipelines and/or valves along the pipeways from any of the above conditions that could release natural gas into the environment.

Incomplete assessment of seismic risks

The proposed "significance criteria" appear to be reasonably stated. However, due to the substantial amount of missing data on earthquake faults and the incomplete assessment of seismic hazards (both discussed above), the scope and extent of reasonably foreseeable risks associated with such hazards remain unknown. So the Applicant cannot have identified all of the significant potential risks (not even substantially).

G434-133

As a threshold matter, the baseline for what constitutes a potentially significant quake has not been established. The DEIS/R does discuss maximum foreseeable quake magnitudes; but the potential significance of any quake of a given magnitude in a given location has not been assessed – for the simple reason that the design criteria for many seismically-vulnerable project components such as pipelines have not been finalized. Neither we nor the Applicant yet knows what the project is with enough precision to be able to say what a significant quake might be.

G434-134

Even where the DEIS/R does attempt to identify seismic risks, the discussion is often vague or uncertain. For instance, the report refers to calculations of peak ground acceleration (Pga)[193] derived from CalTrans and the California Geological Survey (CGS) as being "favorable."[194] But that assessment is unsubstantiated; the cited CalTrans data is "internal" and unavailable. Nor is the significance of the data discussed; the Report says only that CalTrans estimates that Pga in

[193] Pga is used to determine how strong structures must be designed to withstand ground motion.
[194] 4.11-22.

G434-133
Section 4.11.1.3 address this topic and includes additional information.

G434-134
Peak ground acceleration (Pga) is a measurement of earthquake shaking used in design to ensure that project components may withstand such ground shaking. The numbers do not have a set significance in and of themselves (see Section 4.11.1).

Because the CalTrans report (which was cited in another reference) is not publicly available, California Geological Survey calculations, which are publicly available, were used to validate the values in the CalTrans report. See references for Section 4.11.

G434-134 cont'd

the project area could be "between 0.5 and 0.7 times the gravitational acceleration."[195] What is the significance of that? What is the scope and extent of the locations surveyed?

G434-135

The Report also says that "CGS states that the calculated Pga value has a 10 percent probability of being exceeded in 50 years."[196] This may or may not be accurate; no substantiating data is provided. What *is* given is that only three locations in the entire project area were selected for calculation; and these locations are unspecified, so there is no way to tell whether the probability value attributed to CGS is in any way representative or meaningful.

G434-136

Moreover, the DEIS/R does not fully address the following two paragraphs, originally presented in my comments on the Scoping Draft:

Southern California is "overdue" for a mega-quake. [I am not certain of the exact numbers, but the gist is that a key point on the San Andreas Fault experiences a huge quake every 150 years with regularity, and that it is now something like 20 years "overdue," such that geologists roundly agree that there should be a quake of >8.0 in the L.A. in the next ten years with something like 80% confidence. That will be a number to research further – it will be fairly damning. For a quick comment on it, call Caltech Seismology Lab, in Pasadena.]

That "mega-quake" risk is particularly high in Ventura County. After the Northridge quake, geologists at the Southern California Earthquake Center did a study finding that "Ventura County's fastest-moving faults are capable of shaking the region as hard as the Northridge quake shook the San Fernando Valley -- or harder."[197] According to the Center's 1995 report, "the Santa Cruz fault beneath the Channel Islands…has the potential to unleash an earthquake as strong as magnitude 7.4."[198] "With three fast-moving faults converging in Ventura County and no history of a severe earthquake since 1812, the region is due for a bad one," according to Bob Yeats, an expert on the county's fault-line system.[199] And, it should be pointed out, Ventura County carries the state's highest seismic danger rating.[200]

Proposed mitigation of seismic risks is hypothetical

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Because the assessment of seismic risks remains substantially incomplete, many if not all of the proposed mitigation measures are necessarily hypothetical at best. Tellingly, the DEIS/R admits this implicitly, in the way that it blends discussion of impact *analysis* and *mitigation* measures into a single section (4.11.4). Many mitigation measures are essentially left "to be determined," because the potential risks remain indeterminate – as do many of the pertinent technical studies and design specifications.

195 4.11-22.
196 *Id.*
197 Reed, Mack, *Experts Say Area Ill-Prepared For Quake*, Los Angeles Times, January 29, 1995, Ventura Ed., B1.
198 *Id.*
199 *Id.*
200 *Id.*

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The various locations selected along the proposed route were selected as representative locations. Other latitudes/longitudes could be selected to calulate peak ground acceleration for each location. See the response to Comment G434-134.

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The EIS/EIR acknowledges that Southern California is very seismically active with a high likelihood of a strong quake near the proposed Project. See Impact GEO-3 in Section 4.11.4.

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The engineering guidelines for gas pipelines are based on modeling and experience with pipelines around the world. As stated in 4.11.1.10, the lead agencies do not require deepwater port applicants to provide final detailed designs as part of their application. Mitigation Measure GEO-3c in Section 4.11.4 states that final site-specific seismic hazard studies must be approved by the CSLC and USCG prior to construction.

One representative example illustrates the vague, tautological nature of section 4.11.4 in its entirety. The impact of "GEO-4" is summarized as

> "Damage to pipelines or other facilities could occur due to direct rupture (ground offset) along fault lines (Class II)."[201]

The proposed mitigation measure is summarized as

> "MM GEO-4a. Design for Ground Shaking. Complete proper seismic design; follow specified guidelines."[202]

Note that the "proper seismic design" is admittedly *incomplete*; pipelines have not yet been designed for ground shaking, and the specified guidelines have not yet been followed. None-theless, the Applicant then concludes,

> "Adherence to this mitigation measure would reduce the impact to less than significant."[203]

This conclusion is entirely premature and unsubstantiated. In simple terms, the Applicant has essentially said, "even though we don't know the seismic risks, we are confident that our pipe-lines (and other structures) will be adequate." Likewise goes the entire remainder of the section on seismic risk analysis and mitigation.

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A few more representative examples of incomplete analyses of seismic risks and consequent mitigation measures are as follows:

> "Mitigation Measures for Impact GEO-3: Damage Due to Direct Rupture along Fault Lines [...] A Final site-specific seismic hazard study *shall be completed* and approved by the CSLC and United States Coast Guard (USCG) prior to construction.... Adherence to [this] mitigation measure...would reduce this impact to a less than significant level."[204]

But at this point, without having completed such a study, the Applicant is merely hoping that a future seismic hazard study *might* show the project to be viable. Given the project's novel combination of technologies, overall complexity, still-uncertain design specifications, and high-magnitude risks, all studies of such fundamental significance as seismicity should be performed *in advance* of project approval.

> "Mitigation Measures for Impact GEO-3: Damage Due to Direct Rupture along Fault Lines [...] It is best to orient the pipe at fault crossings to produce tension in the pipe if there is ground rupture along the fault. Compression of the pipe is

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[201] Table 4.11-4, at 4.11.30.
[202] *Id.*
[203] 4.11-35.
[204] 4.11-33,34.

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The pipelines would be designed and installed in accordance with the laws, regulations, and guidelines listed in Table 4.11-3.

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The November 5, 2004, report, "Assessment of Potential Seismic Hazards to Cabrillo Port Facilities" by D.G. Honegger Consulting, contains engineering and modeling data and concludes, "The offshore pipelines are not expected to experience strains greater than 0.5% nominal yield strain of the pipe material for an unburied condition or greater than 1.5% for the case of full pipeline burial for any earthquake related ground displacement scenario considered. These strains represent a large margin of safety..." See the response to Comment G434-137 also and Section 4.11.3.

The statement, "Anywhere that the pipe were 'tensioned' it would necessarily undergo equivalent compression elsewhere along its length" is not correct. Most major faults in California exhibit mainly lateral movement -- they are strike slip faults. For pipelines that intersect either strike slip or normal (up/down) faults at near right angles, the pipe would be put under tension without associated compression. Nevertheless, compression buckling was also modeled in the Honegger report.

The Project has been modified since the issuance of the 2004 Draft EIS/EIR and HDD is no longer being proposed for use at the shore crossing. HDB would be used instead. As discussed in Section 2.6.1, "HDB has been used since 1977 to install large-diameter pipelines beneath environmentally sensitive areas such as waterways and surf zones. According to the preliminary geotechnical studies, the geologic formation through which the proposed Cabrillo Port landfall would be installed is primarily sand, which is suitable for HDB." For more information see Appendix D4.